



## **Preliminary Assessment of Coastal Shoreline Change in the Southwest Alaska Network (SWAN)**

William F. Manley  
Leanne R. Lestak  
Alan Bennett

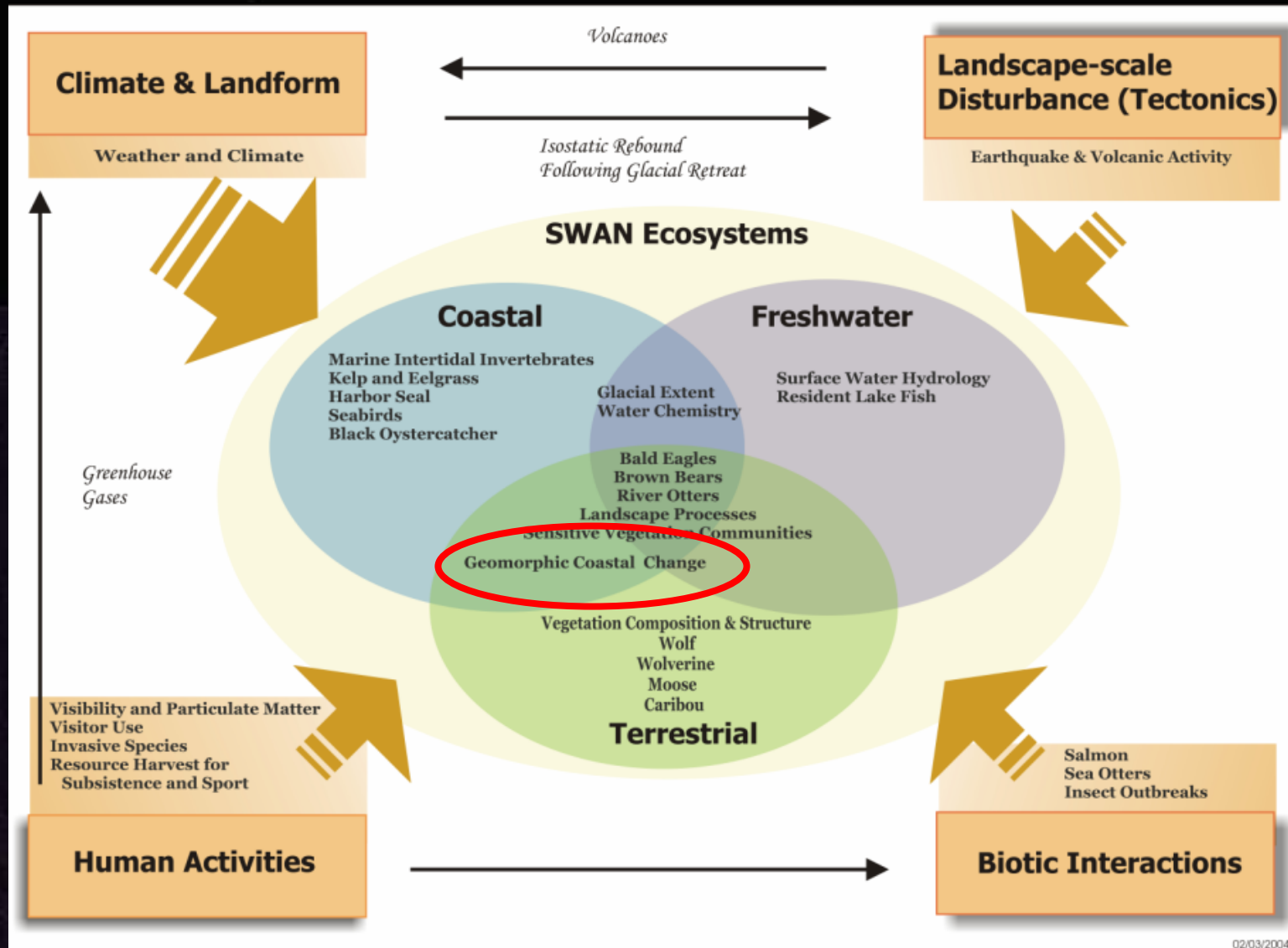
INSTAAR, University of Colorado  
INSTAAR, University of Colorado  
Network Coordinator, SWAN

# Coastal Shoreline Change

- Rapid, large-magnitude, observable change is occurring to park coastlines
- Changes in the position of the shoreline influences coastal habitats, archeological resources, and has jurisdictional implications
  - *change in frequency and intensity of storms*
  - *sea level rise*

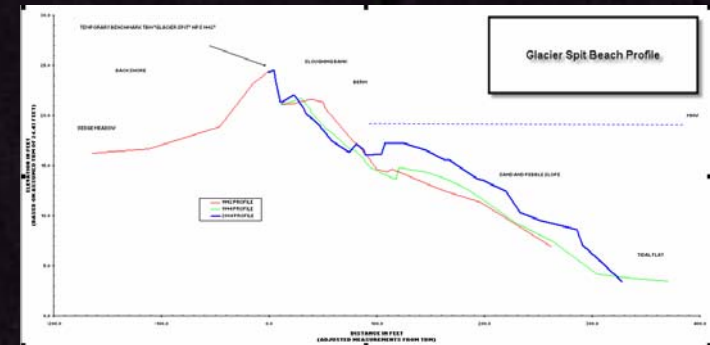
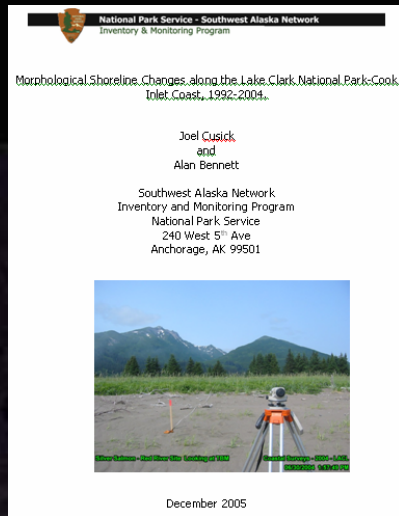


# SWAN Vital Signs

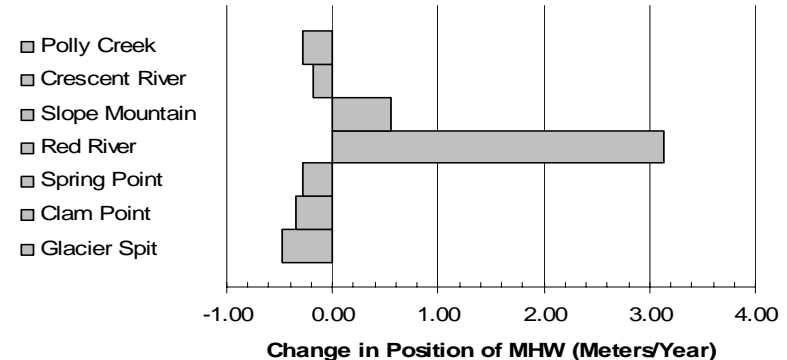




To evaluate the type of shoreline changes occurring along the 82 km coastline of Lake Clark National Park and Preserve, Cusick and Bennett (2004) surveyed 7 of 10 cross-shore beach profiles established in 1992.



Cross-shore beach profiles revealed variation in rates of erosion and accretion along the parks coastline. Erosion, landward migration of mean high water (MHW), was observed at 5 cross-shore profiles and accretion, seaward migration of MHW, was observed at 2 profiles. Annual average rates of erosion and accretion ranged from -0.18 to -0.50, and 0.55 to 3.13 m/yr respectively.

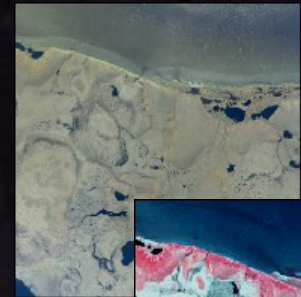


# Remote Sensing & GIS Approach

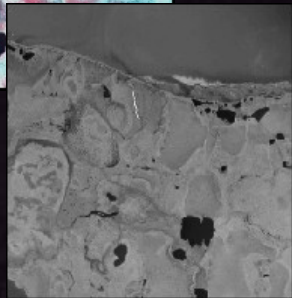
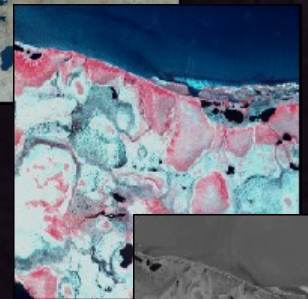
- Advances in technology, imagery, and datasets enable us to:
  - directly measure rates of erosion and accretion
  - study the entire coastline



High-resolution IKONO's base imagery



Historic aerial photographs





# Project Goal

The purpose of this project is to develop a strategy for long-term shoreline change analysis based on a time series of rectified aerial photographs extending as far back as the 1950's. The strategy will involve defining a consistent shoreline reference feature (SRF) -- digitized from the photos in a GIS -- to quantify the migration of the SFR over time.



## 2004 - 2005 IKONOS Imagery

- 4 band IKONOS satellite imagery – Red, green, blue, color IR (CIR)
- mosaic created by Space Imaging
- 1 m resolution
- 16 bit data, geoTIFF format
- accuracy: unknown
- Only available for KEFJ and ANIA
- 68 files, 110 GB: lots of imagery!
- highest res. for SWAN parks
- valuable for other types of research



## ca. 1980 Aerial Photos

- from Alaska High Altitude Photography (AHAP) program
- Color Infrared (CIR)
- 300 dpi scan res = 5 m orthorectified resolution, not adequate
- 1:60,000 – 1:65,000 scale
- Not orthorectified!
- Not complete yet for entire coastline of ANIA, KATM, KEFJ
- Entire dataset size so far = 22.5 GB



## ca. 1950 Aerial Photos

- from USGS
- Black and white
- ca. 1:43,000 scale
- 476.19 dpi scan resolution = ca. 2.5 m orthorectified resolution
- NOT orthorectified!
- Not complete yet for entire coastline of ANIA and possibly other parks
- Entire dataset size so far = 250 GB

## Example from Arctic Network (ARCN) Parks, Alaska

- Next several slides ...





## Shoreline Reference Feature (SRF):

“bluff top” (wave-cut scarp)



Mainland bluff



Barrier island or spit



Beach ridge complex



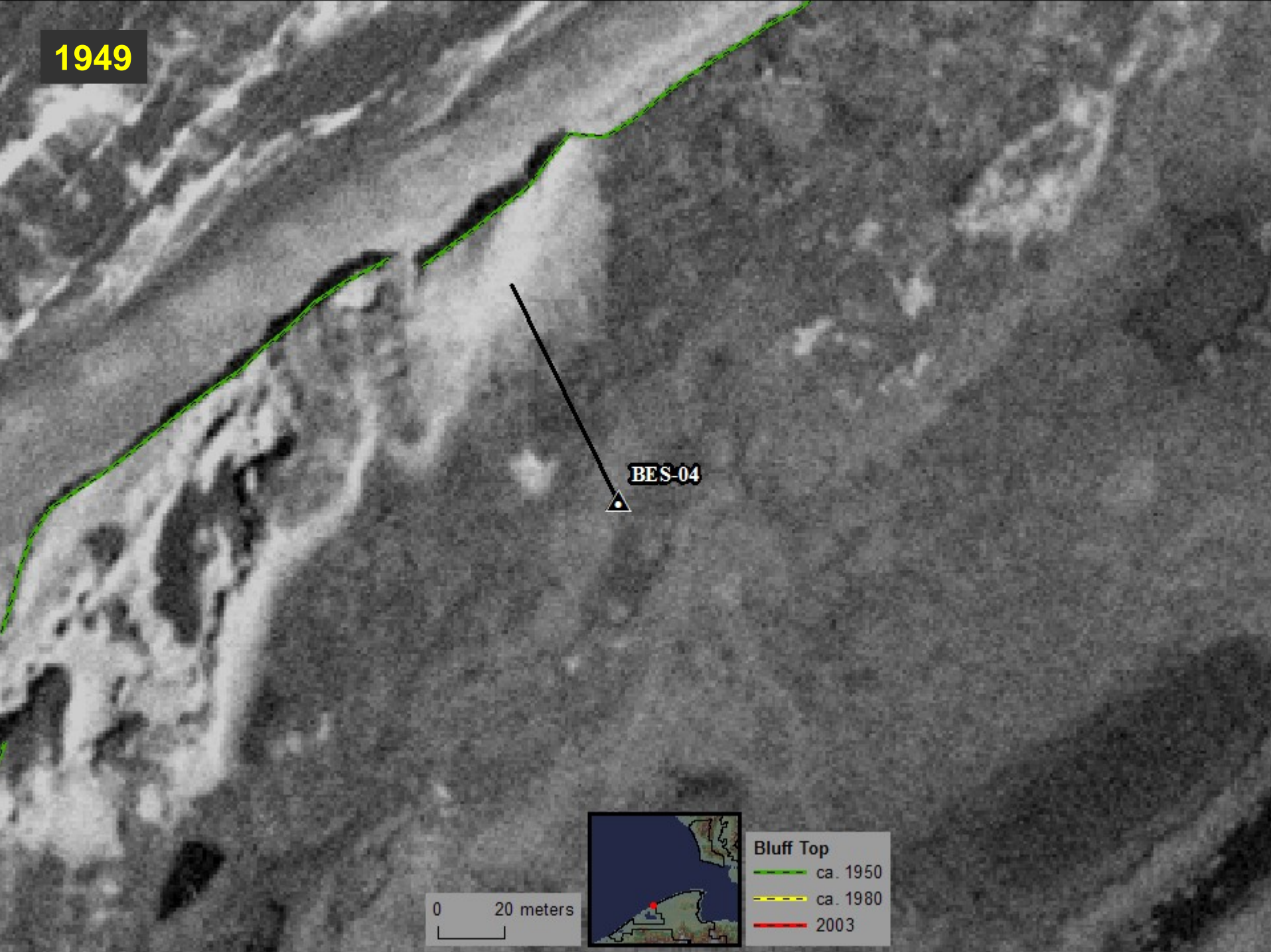
1949

BES-04

0 20 meters

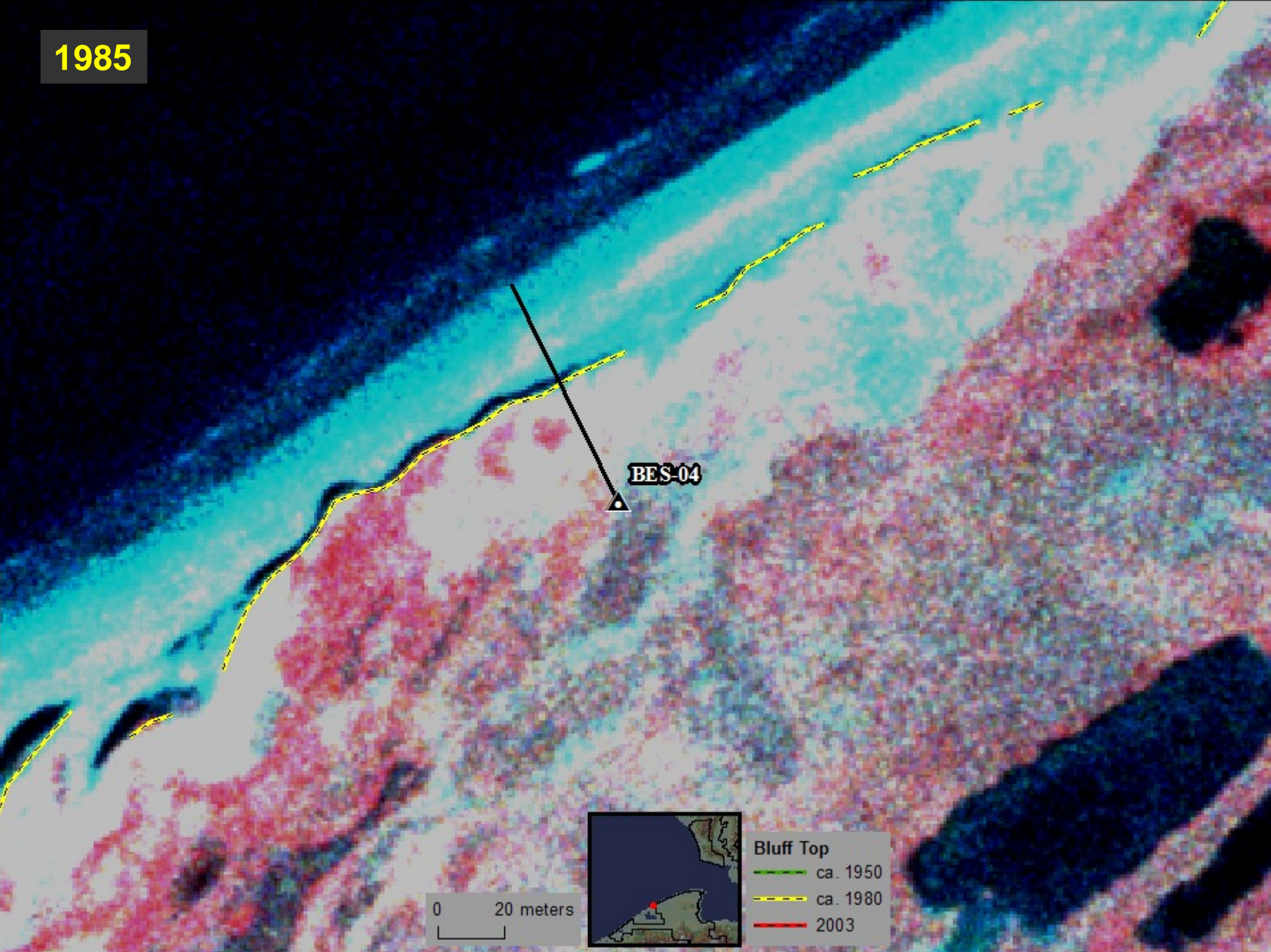
Bluff Top

ca. 1950  
ca. 1980  
2003





1985



BES-04

0 20 meters



Bluff Top

ca. 1950  
ca. 1980  
2003



2003



BES-04

0 20 meters

Bluff Top

ca. 1950  
ca. 1980  
2003





# DSAS

## The Digital Shoreline Analysis System (DSAS) version 3.0, an ArcGIS® Extension for Calculating Historic Shoreline Change

by E. Robert Thieler<sup>1</sup>, Emily A. Himmelstoss<sup>1</sup>, Jessica L. Zichichi<sup>2\*</sup>, and Tara L. Miller<sup>3</sup>

<sup>1</sup>Coastal and Marine Geology Program, U.S. Geological Survey, Woods Hole, MA 02543

<sup>2</sup>Perot Systems - Science and Technology Solutions Group, Pembroke, MA 02349

\* present address: GeoNet Systems [www.geonetsystems.com](http://www.geonetsystems.com)

<sup>3</sup>Coastal and Marine Geology Program, U.S. Geological Survey, St. Petersburg, FL 33701

### U.S. Geological Survey Open-file Report 2005-1304

2005

**If you use the DSAS extension, please cite the following publication:**

Thieler, E.R., Himmelstoss, E.A., Zichichi, J.L., and Miller, T.L., Digital Shoreline Analysis System (DSAS) version 3.0; An ArcGIS® extension for calculating shoreline change: U.S. Geological Survey Open-File Report 2005-1304.

The current version is 3.2

The following files are available for download:

[Readme\\_dsasv3\\_2.txt](#) (6 kb) - README file with installation instructions, known issues, and version history

[DSAS\\_v3\\_2.zip](#) (2210 kb) - the DSAS extension, compressed zip file

[DSASv3\\_2.pdf](#) (362 kb) - Adobe PDF user guide and tutorial.

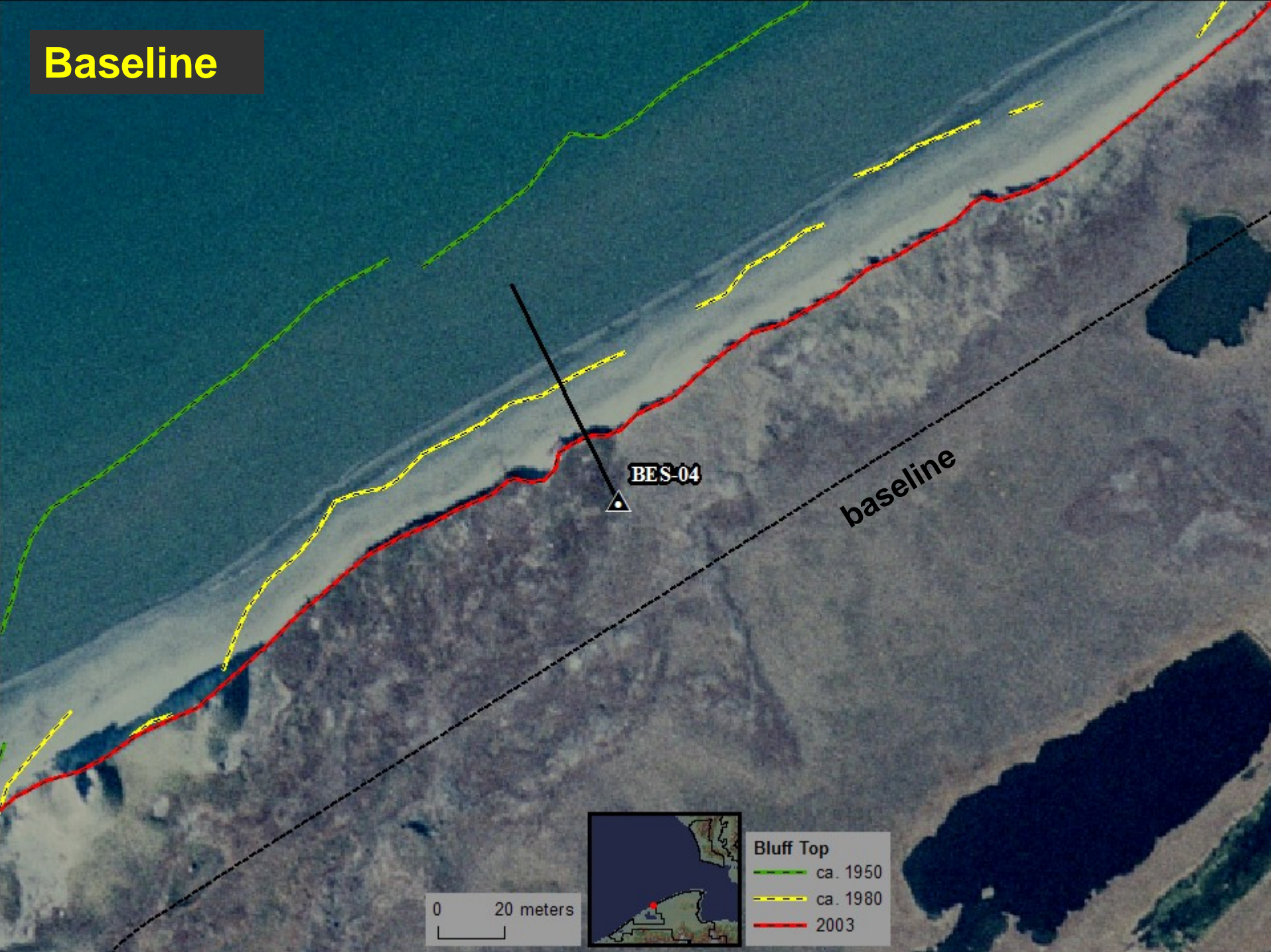
[DSAS\\_sample\\_data.zip](#) (2544 kb) - Sample ArcGIS geodatabase, compressed zip file.

For more information, contact:  
E. Robert Thieler  
[rthieler@usgs.gov](mailto:rthieler@usgs.gov)  
tel: 508-457-2350

The Digital Shoreline Analysis System (DSAS) version 3.2 is a software extension to ESRI ArcGIS® v.9+ that enables a user to calculate shoreline rate-of-change statistics from multiple historic shoreline positions. A user-friendly interface of simple buttons and menus guides the user through the major steps of shoreline change analysis. Components of the extension and user-guide include: 1) instruction on the proper way to define a reference baseline for measurements; 2) automated and manual generation of measurement transects with user-specified parameters; and 3) output of calculated rates of shoreline change and other statistical information. DSAS computes shoreline rate-of-change using four different methods: 1) simple linear regression; 2) weighted least squares regression; 3) endpoint rate; and 4) jackknife iterative regression

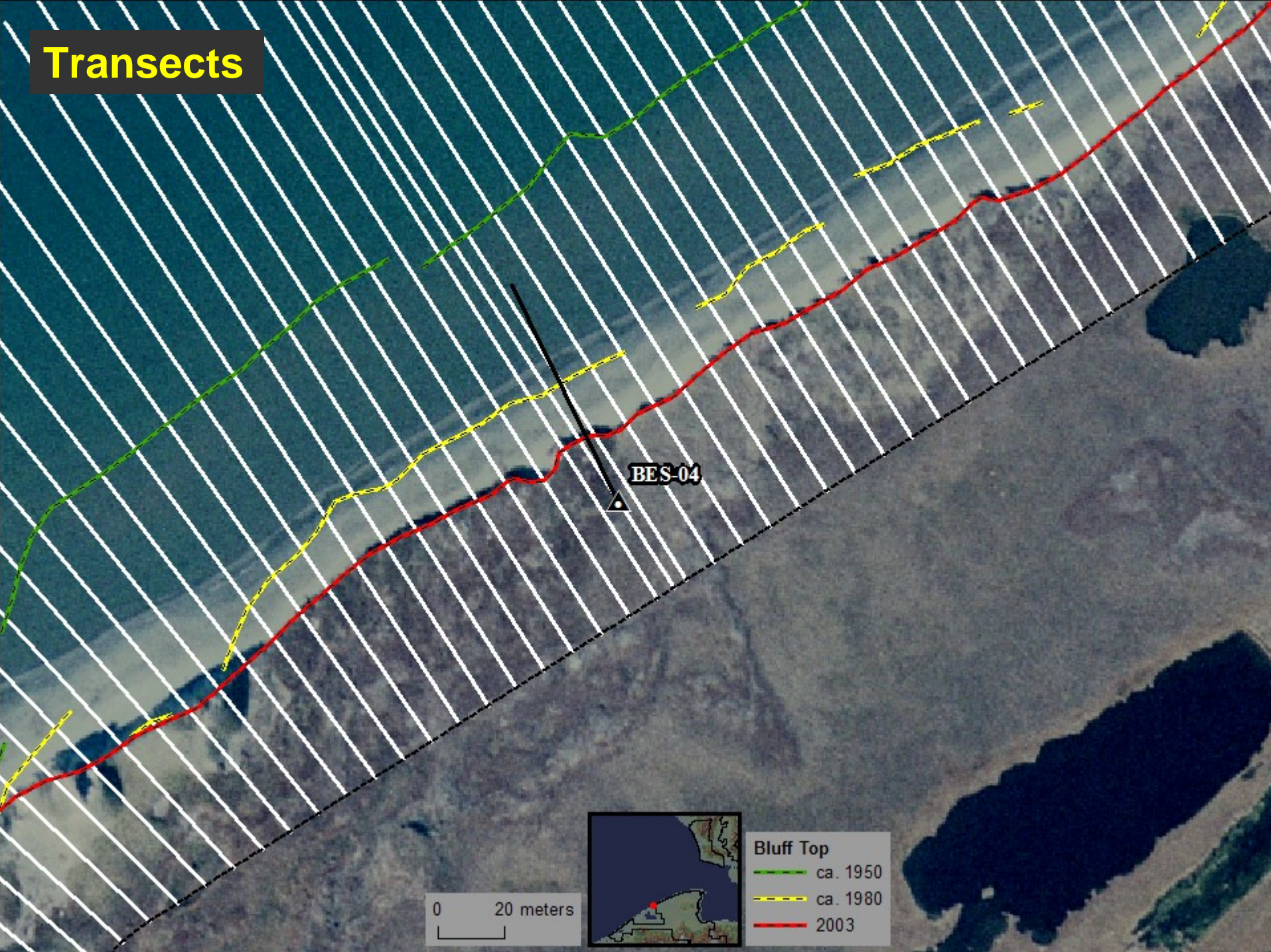


# Baseline



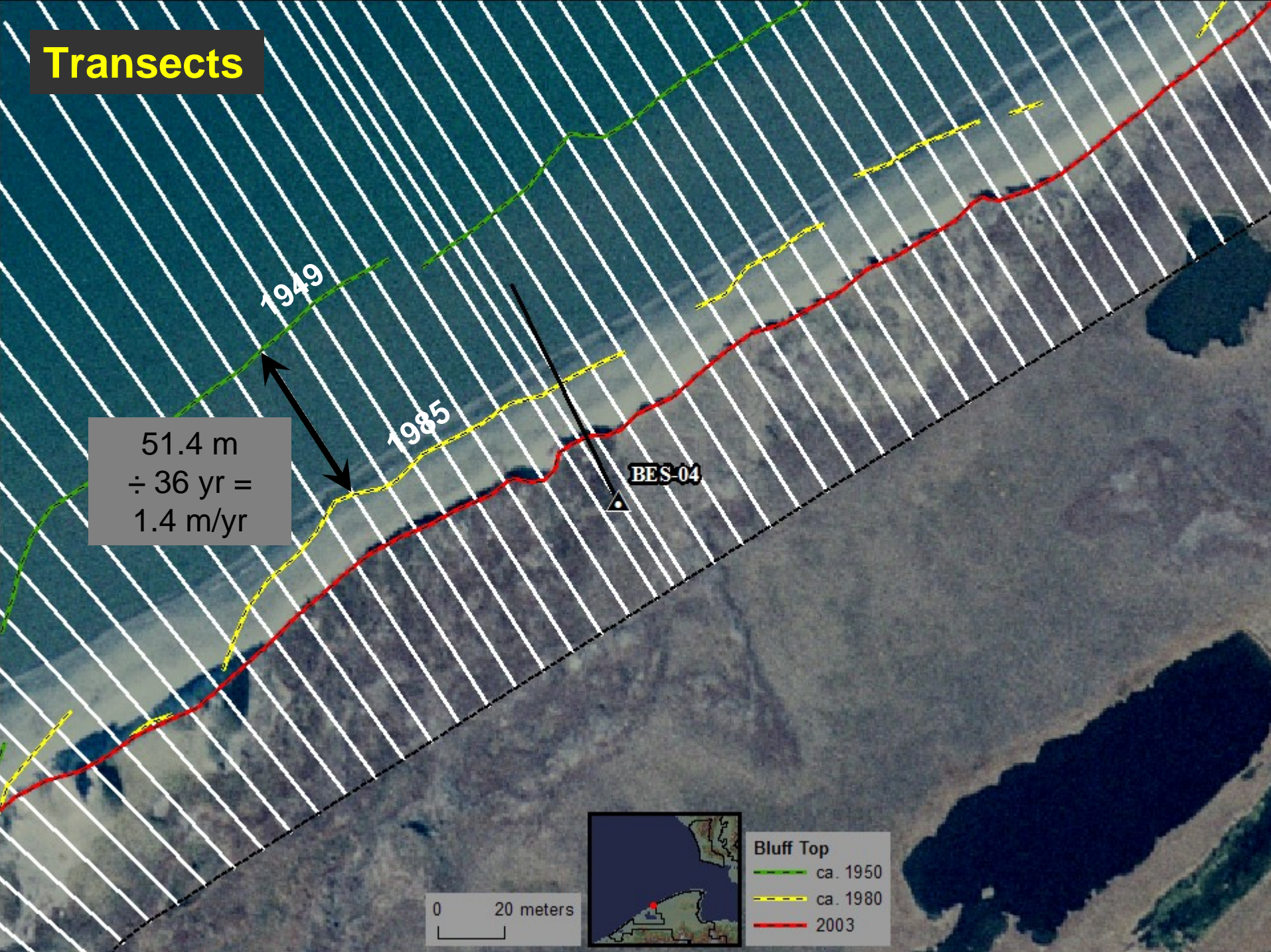


# Transects





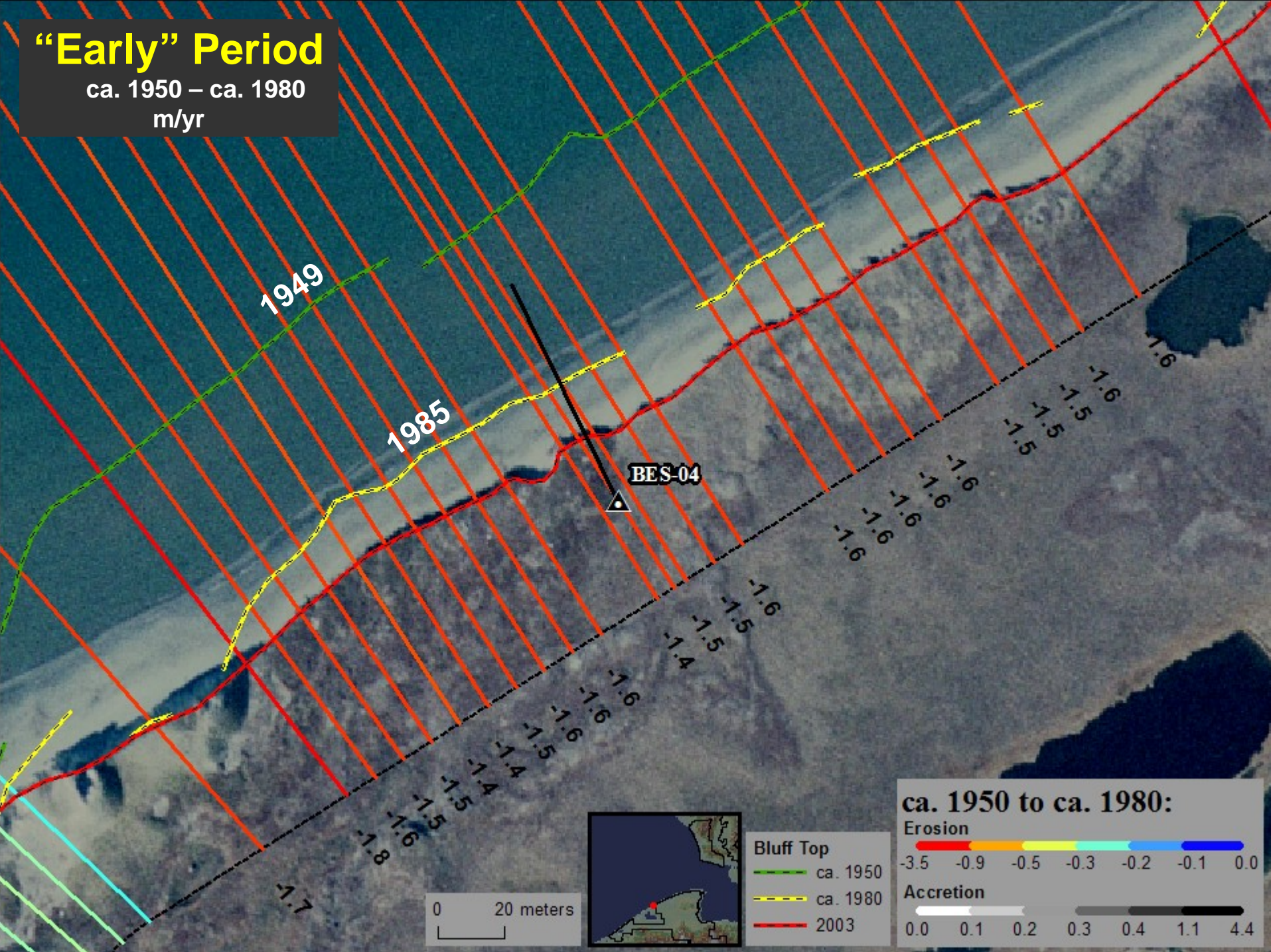
# Transects





# "Early" Period

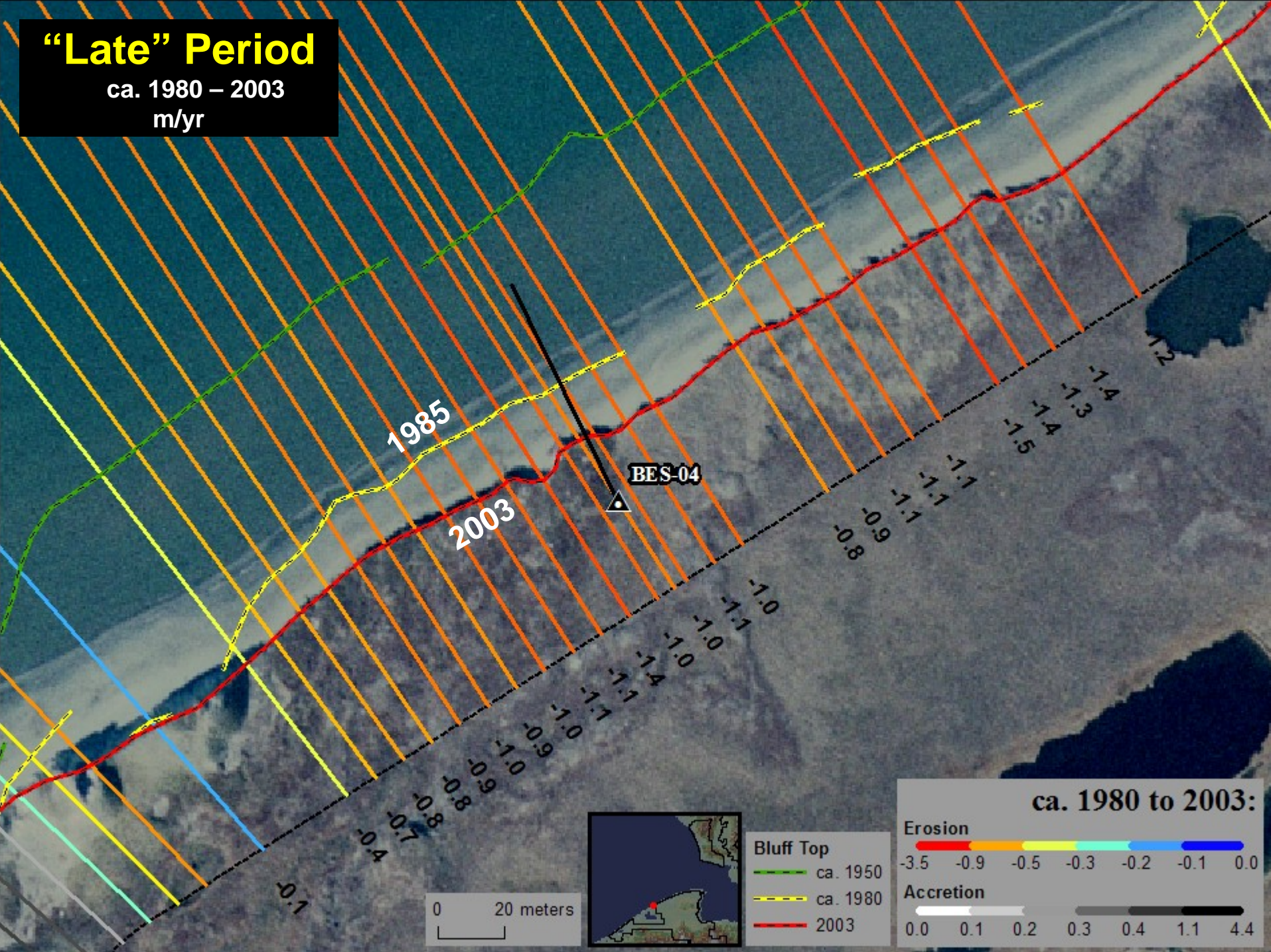
ca. 1950 – ca. 1980  
m/yr



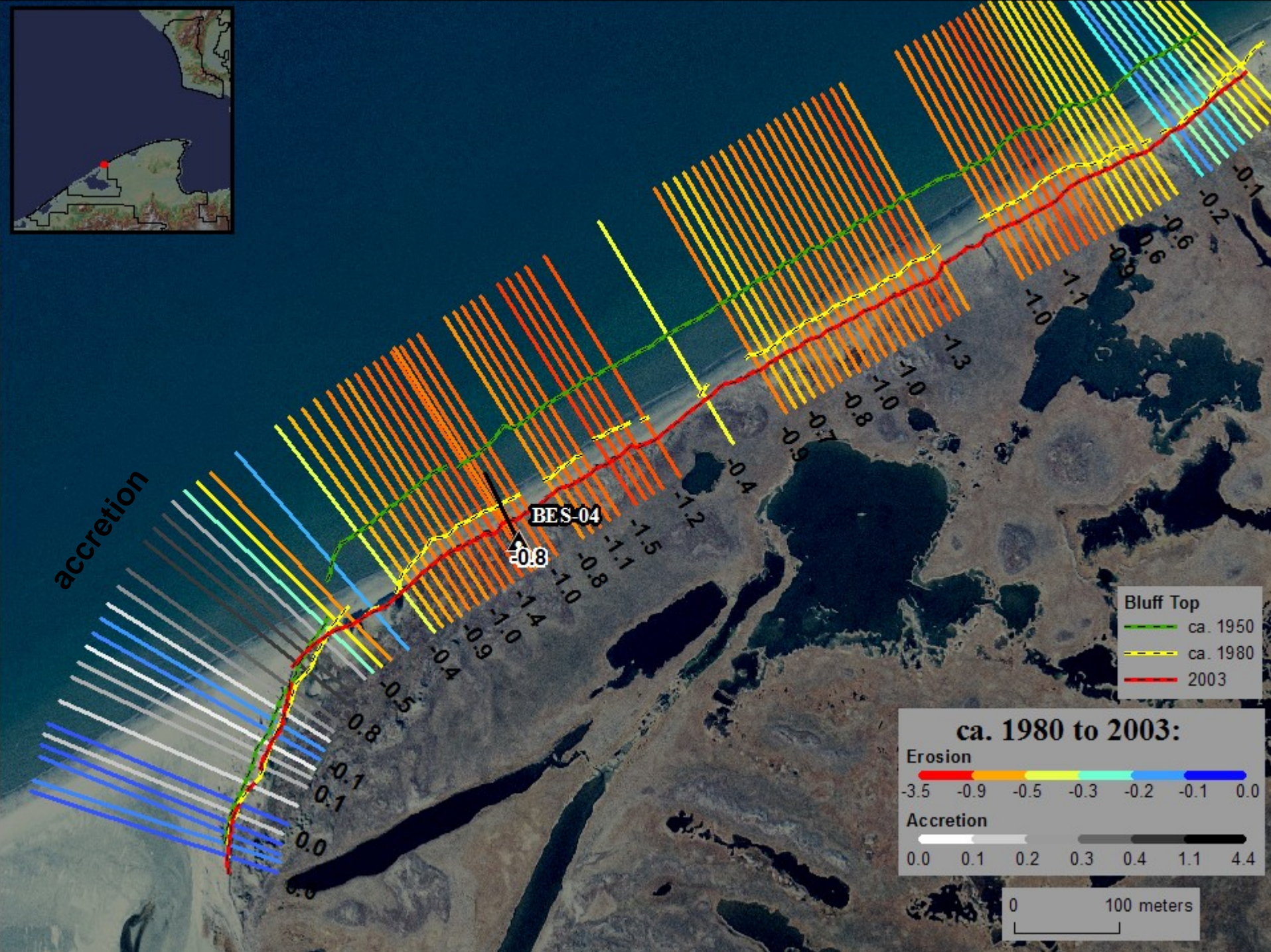


# "Late" Period

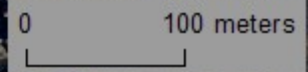
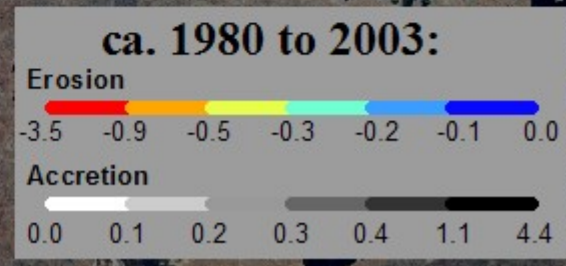
ca. 1980 – 2003  
m/yr







**Bluff Top**  
— ca. 1950  
— ca. 1980  
— 2003





# Steps Ahead for SWAN (2007)

## Assess quality and suitability of existing data and imagery :

- Review all black and white photography and IKONOS imagery that has been acquired for the SWAN coastline.
- Identify additional sources of photography or imagery for acquisition.
- If needed, scan and create digital images of photography

## Evaluate the potential of data and imagery for coastal change studies :

- Select target segments of shoreline for change analysis in one of the park units.
- Orthorectify IKONOS image
- Orthorectify 1 frame for each time slice with control and check points
- Possibly apply USGS DSAS coastal change software

## Appraise potential sources of error (i.e. ortho-rectification, tidal, and tectonic) :

- Digital elevation model (DEM), control points,
- Tidal datum, photos tidally coordinated
- Landslides, change due to tectonics



**Thank you!**

Any questions or concerns:

[William.Manley@colorado.edu](mailto:William.Manley@colorado.edu)

303-735-1300